TOPEX/POSEIDON - A STRONG CONTRIBUTION TO THE GLOBAL MONITORING OF INLAND WATER

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It is often difficult to obtain ground gauge data for many of the world's large inland water bodies, due to poor data distribution or the logistics of difficult terrain. The application of satellite radar altimetry offers a method of acquiring level-change information at a certain temporal and spatial resolution. TOPEX/POSEIDON (T/P) has demonstrated not only the ability to monitor inland seas and lakes, but wetlands, large rivers and their floodplains, to a previously unattainable remote sensing accuracy.

The TOPEX/POSEIDON Mission

The longevity of the T/P mission coupled with its relatively short 10-day temporal resolution, and the most accurate altimetric satellite orbit to date, offered great potential to the exploration of this dataset with respect to altimetric performance over inland water. Excellent results, accurate to ~4 cm rms, were achieved for inland seas, lakes and reservoirs [Birkett, 1995a].

Its success in presenting level-change time series for remote regions gained interest from a wide community. One particular collaborative project with the World Conservation Monitoring Centre, and sponsored by the United Nations Environment Programme, concerned the implementation of a prototype "Global Lake and Catchment Area Conservation Database". Its aim is to contribute new global environmental data and information for large lakes, and thus help support the monitoring and management of inland water and biological resources, The database, freely available on the Internet via the World Wide Web (http://msslsp.mssl.ucl.ac.uk/orgs/un) contains both remote sensing results (synergistic level changes from T/P and surface area measurements from NOAA/AVHRR) and environmental information (Figure 1).

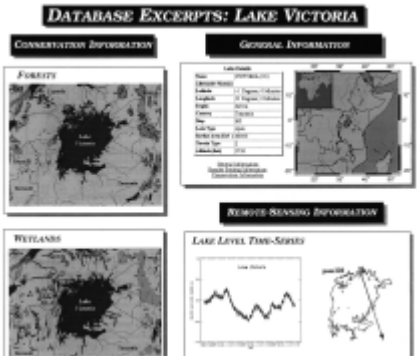

Figure 1
Excerpt from the Global Lake and Catchment Area Conservation Database (http://msslsp.mssl.ucl.ac.uk/orgs/un) showing remote sensing and conservation information for Lake Victoria, Africa. TOPEX/POSEIDON data (centre) from one particular pass is used to show the changing levels of the lake.

(372 Kb)

Another collaborative project was initiated under the GEWEX programme to study the hydrology of the Mackenzie Basin. Modelling hydrological processes in large watersheds flowing to the Arctic is one step towards larger-scale modelling of the global water and energy cycle. Models of the basin currently omit explicit routing of river flows through its three main lakes, Great Bear, Great Slave and Athabasca. With few gauges available, the T/P dataset was utilized, together with NOAA/AVHRR imagery, to determine the hydraulic relationships (i.e. the relationships between level, area and volume, and discharge) of these large lakes [Birkett and Kite, 1997].

The success of T/P over lakes was further extended to its application over large rivers and wetlands [Birkett, 1995b, Birkett, 1997]. Remarkably, the NASA radar altimeter (NRA) shows great stability over these regions, where surface conditions are such that the returned radar echoes are no longer ocean-like in appearance, but narrow-peaked with high radar backscatter coefficients. Early results were presented at the IGBP-wetlands workshop in Santa Barbara in 1995, where experts met to discuss the relevance of wetlands under the overall issues of global warming.

TOPEX/POSEIDON Extended Mission and Jason-1

The prospect of an extended T/P lifetime of 6 years, and of the follow-on Jason-1 mission gives good grounds for monitoring these inland water bodies well into the next century. With additional altimetric data from the ERS-1 and ERS-2 radar altimeters, we can begin to accumulate a solid 10-15 year dataset of inland water level changes.

The range of applications for this altimetric dataset is quite interdisciplinary in nature with applications in water resources, climate change and hydrological monitoring. The dataset will serve as a tool from which to explore the links between local climate change and both volume changes in climatically sensitive lakes, and the growth and decay of lake ice. Changes in stored water volumes will also contribute towards the study of variations in the mass distribution of water and its effect on the Earth's rotation and gravity field. Other projects will examine the hydrology of large river and wetland systems, deducing river gradients and hydraulic rating curves.

Global Lake Conservation Database users are also suggesting that additional parameters such as water quality, soil maps, climatic datasets, and land use be included in future versions, and in addition that rivers and wetlands be incorporated. The question has also been raised as to the prospect of near real-time flood monitoring, a potentially interesting project which will ultimately be bound by the availability of fast-delivery 10 Hz data.

***References**:*

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